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&

Student Streamside Incubation Project
1997

Indian Summer III

Acknowledgments

The Indian Summer III project was sponsored and funded by the U.S. Department of Navy, Office for Naval Research (ONR). The Indian Summer research and development program was adminstered by the Idaho National Engineering and Environmental Laboratory (INEEL) Institute under Director, Francis Grant. The U.S. Department of Energy (DOE), through the INEEL Institute, funded the mentor and non-Tribal students and teachers. With the assistance provided by these agencies, our teachers are able to work with national laboratories and technology centers to enhance their leadership skills, increase their awareness of current science and technology, and tranfer this knowledge to their students.

As the third year of Indian Summer draws to a close, we would like to extend our appreciation to the people and organizations who helped make the project a reality for the students.

Ed Galindo—As a Native American science teacher at the Shoshone-Bannock Junior/Senior High School, Ed continues to provide his students with the resources, enthusiasm, and care that all young people need and deserve. Ed's commitment to his profession and to his students is rewarded each year when his students graduate and begin to work toward their goals.

Ben Rinehart—With DOE's Hydropower Program for 17 years, Ben is a science and engineering mentor through the INEEL. In support of the TRAC educational programs, Ben provides technical advice, resources, and yearly support to the Indian Summer projects.

Dirk Kempthorne—Senator Kempthorne made a substantial contribution to the project this year by sponsoring legislation to make Basin Creek a free area where no activities, such as mining, can take place. This allows the creek to return to a natural state that will enhance salmon and trout spawning areas and assist in their recovery.

U.S. Army—Thanks to Major Meckley, who is in charge of the JROTC program at the Shoshone-Bannock High School. SFC John Moeller and Major Meckley provided the camping gear, Army rations, and fun outdoor activities, like river rafting and camping. It was great!

J.R. Simplot—Gerald McNabb and his staff analyzed our samples for mercury, lead, and arsenic, among others. We appreciate their time and effort to help us determine what the samples contained.

U. S. Forest Service—Bruce Smith, a Forest Fisheries Biologist for the Salmon and Challis National Forests, provided information on the cycle of steelhead and salmon, the environments they thrive in, and hatching methods and devices. Thanks to the Leadore, North Fork, Challis, and Yankee Fork ranger districts.

Private landowners and site hosts—Fred Porter, Jim Bower and Mary Bullard, Jack Ellis Ranch, John Burns Ranch, Scott Turner Ranch, Bruce Mulkey Ranch, and Dave Richmond.

Idaho Fish and Game, Region 7—Mike Larkin, Fisheries Supervisor and Gary Bertellotti, Pahsimeroi Hatchery Manager.

Program Assistance—Sawtooth Hatchery; Idaho Model Watershed Project, Jude Trapani, Coordinator, and Scott Turner, North-end Hatching Coordinator; Flaming Gorge/Lower Green River Chapter, Wyoming Trout Unlimited.

Idaho Rivers Unlimited—This organization provides us with a voice in the public sector. They have been instrumental in spreading the word of our achievements with the steelhead eggs.

Shoshone-Bannock Tribe—Thanks to the Fisheries Department for their technical support and egg supply and Lavern Broncho for teaching the Tribe's viewpoint on science; Shoshone-Bannock School and our principal, Dr. Shortman, for supplying the buses and drivers; Shoshone-Bannock faculty for giving up their summer vacations; Tribal Elders and our parents for their words of encouragement and cultural views. A special thank you to John Moeller, Ben Bloom, and Linda Jay for putting up with us for 12 weeks during their summer vacation. In spirit and on the road, we cover many hundreds of miles. Thanks to everyone.

The Indian Summer Story

Here lives my story. It happened long ago that there was a man named Zimo who was a good planter. He cared well for his crops and he gave thanks to Ketci Niweskewe. But when the time came for him to do his planting, he became sick. The other people of his village planted their crops and harvested them and dried them for the winter, but Zimo remained sick all through that time. The other people of the village and their families had plenty of vegetables, but Zimo had none. The first cold winds of late autumn were blowing and he knew it would be hard to survive the winter without the food he always got from his fields.

So Zimo went to Gluskabe.

'Master,' Zimo said, 'I have been sick. The time came to plant and then the time to harvest and now I have no food for the winter. I have always been thankful, and I have worked hard in the past. Help me.'

'Go back to your field,' Gluskabe said. 'Plant your seeds.'

Zimo did as Gluskabe said. The people of Zimo's village thought he was crazy as he began to plant his corn and squash and beans. But as soon as he put the seeds in the earth, the weather changed and it became warm as summer. The seeds sprouted and grew tall overnight. By the time seven days had passed, Zimo had gathered a whole season's crop. Then winter came.

Since then, though the seeds no longer grow as quickly as Zimo's seeds did with the help of Gluskabe, there is always a time of warm weather just before the snows. That is the time the Penobscot people call 'A Person's Summer.' It is known to most as 'Indian Summer,' even though few seem to remember that it is a time given as a reminder to us all to be thankful for the gifts from Earth and the Creator.

Indian Summer III

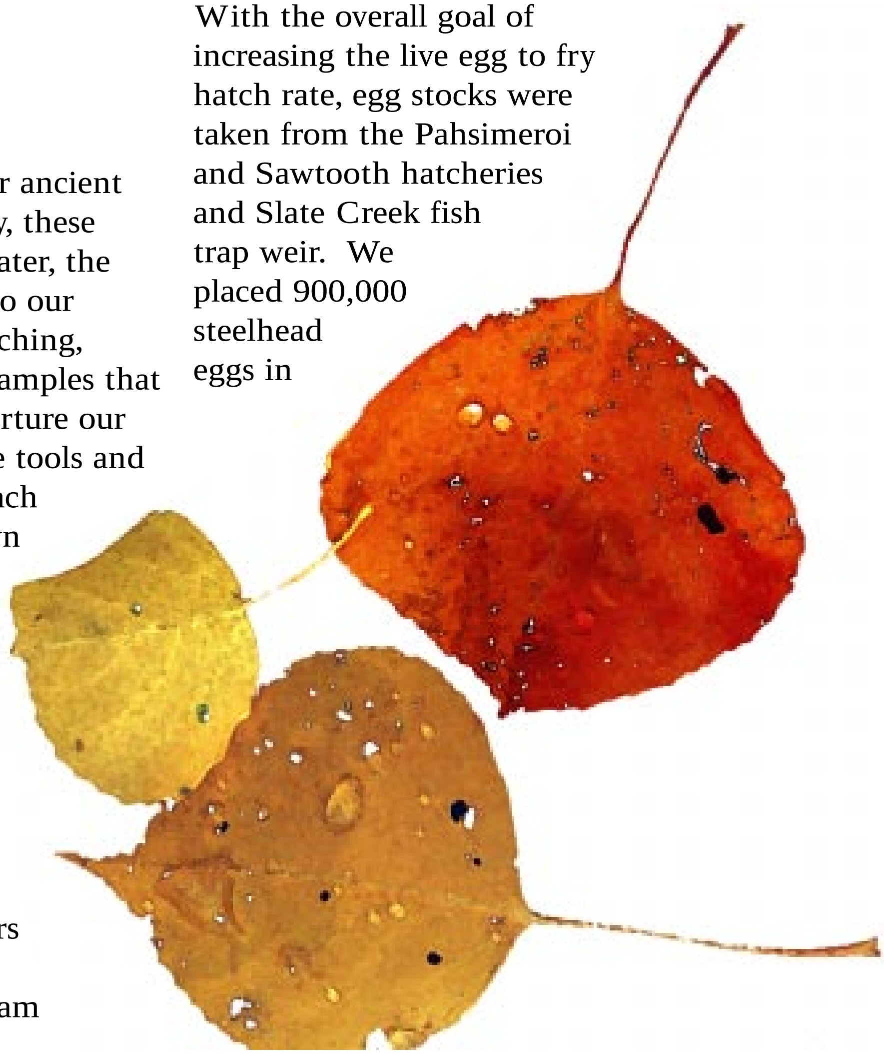
Renewing our Earth's Gifts

Legacy of the Salmon—'*Survival of the Salmon has always meant more than just food for the Indian People. Indians have long recognized that if they are to survive and if their children's children are to survive it will be because the Salmon Survives. It is their legacy.*'—Bill Frank, Jr.

The gifts in life are many as our ancient Native ancestors knew. Today, these gifts—the land, the air, the water, the inhabiting creatures—are the life line to our children's' future. It is through our teaching, understanding, encouragement, and examples that generations to come will renew and nurture our earth. We must provide them with the tools and help them along the way. We must teach them to see and listen beyond their own needs, and to maintain the balance between giving and receiving with the earth.

Each year the Indian Summer project results in renewal and growth for the fish and the students. This project offers all those involved the opportunity to learn and understand natural production and mortality factors associated with fish in early life stages. The 1997 project encompassed 20 stream and tributary sites of the Salmon and Challis National Forests, Sawtooth National Recreation Area, and private lands. It involved 24 students, 5 staff members, and support from the Idaho National Engineering and Environmental Laboratory.

With the overall goal of increasing the live egg to fry hatch rate, egg stocks were taken from the Pahsimeroi and Sawtooth hatcheries and Slate Creek fish trap weir. We placed 900,000 steelhead eggs in



streamside incubators. Again this year, the project focused on assessing stream health, enhancing conditions for egg incubation, and restoring stream habitat. We tried new experiments involving a solar-powered fish data logging device that monitors the outflow of fry from the streamside incubators. We also tested a device called an upweller to see how sediment settled and tested the live hatch rate. The Forest Service, who monitored the hatch project for the north-end sites, tested some new devices too: Jordan/Scotty boxes and a Washington State remote site incubator design. Because we tested new equipment, our total hatch rates were less this year, but we discovered many new concepts that hopefully will increase the hatch rate next year.

In a fisheries recovery project, called the Purcell Springs Stream Ecosystem Outdoor Classroom, the Shoshone-Bannock student team and the Leadore Ranger District of the Salmon and Challis National Forest built island frames. These islands were placed in the stream to provide better water flow and increase nursery habitat by 50%. Several islands were built and placed in the stream and filled with sediment excavated from the channel. Next summer, the teams will return to Purcell Springs and plant willows on the islands and on the banks of the stream, which will provide shade and cover in the stream for the fish. This is just one way that the Indian Summer team is working to rehabilitate waterways the fish will use in their journey.

Another new occurrence was inviting students from the Shelley, Hillcrest, Idaho Falls, and Leadore High Schools to participate. This was the first year that students from outside Fort Hall participated. Our student project provided young Tribal members the opportunity to help develop hands-on workable solutions for a problem affecting the future of Indian fishing culture and for students from different cultures to work side by side. It was a great opportunity for the students to show their strong attachment to the land and their spiritual attachment to the creatures inhabiting the land and seas.

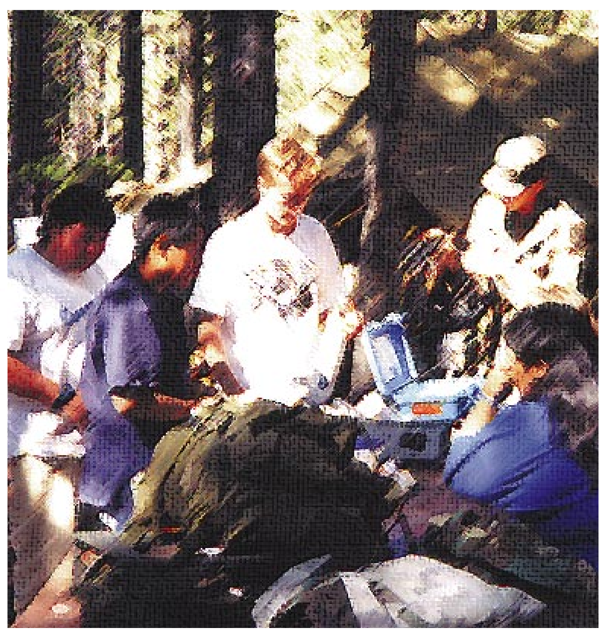
An Indian Summer team placing island frames in the streams to provide better water flow for fish.

Positive Influences and Effects

What is the relationship between the fish project and students' achievements in the world? Both struggle for survival in a continually changing and often hostile, unfamiliar environment. Our goals as educators and mentors should be to assist young people in the transition from a protected environment to the outside world. Much like the fish protected in their incubators, we hope to provide students with an opportunity to grow and mature in a natural setting. The students, through programs like Indian Summer, are developing tools and skills to deal successfully with rapidly changing environments. From our Tribal heritage, we offer the students knowledge of experienced Elders, stories and traditions from the past, and encouragement for the future.

Bringing a cultural mix of students together allows young people to begin to understand one another by working toward a common goal. Our Indian Summer projects are a way to foster the growth of fish and offer a setting where students can open their perceptions to different cultures by listening and effectively communicating beyond all barriers. We can learn about the fish and the environment by doing it together. Did the students learn about fish? Did they learn more about themselves? Yes, I think so.

I would like to think that the project is making a difference for both the fish and students' lives. From these projects, I have seen students grow more confident and bond with each other. Two of the students completed the full 10 weeks of the program, and the fisheries department has shown interest in hiring our students because of their ability to build the incubators and record data. Some students are doing well and some are struggling. This is life. I wonder about the young fish. Are they happy? Are some struggling? The answer is probably yes to these questions.



Fish Issues
We Are Making Progress

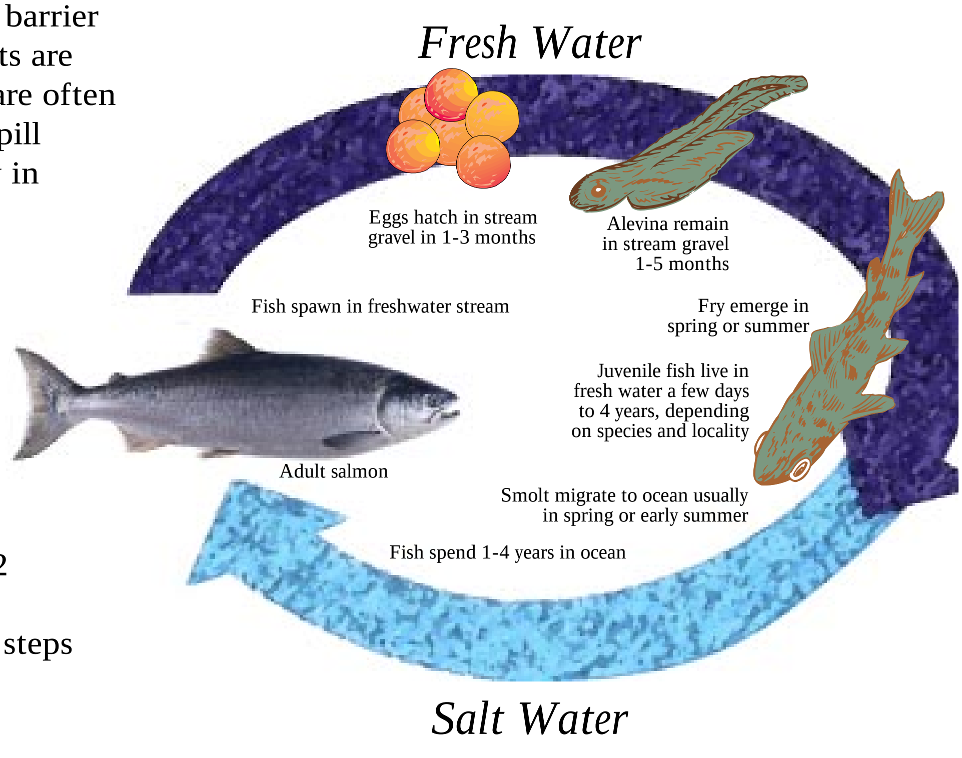
Reaching home streams to spawn is a difficult journey for salmon and trout. Dams, land use, and increasing pollution lessen the chances of the fish reaching their birthplaces to spawn. In the past 3 years, however, progress has been made to improve the climate for fish recovery. Measures have been taken to provide a balance for the young salmon and steelhead by improving river conditions for migration during the spring and by providing cool water when needed in the fall to improve steelhead and fall Chinook runs.

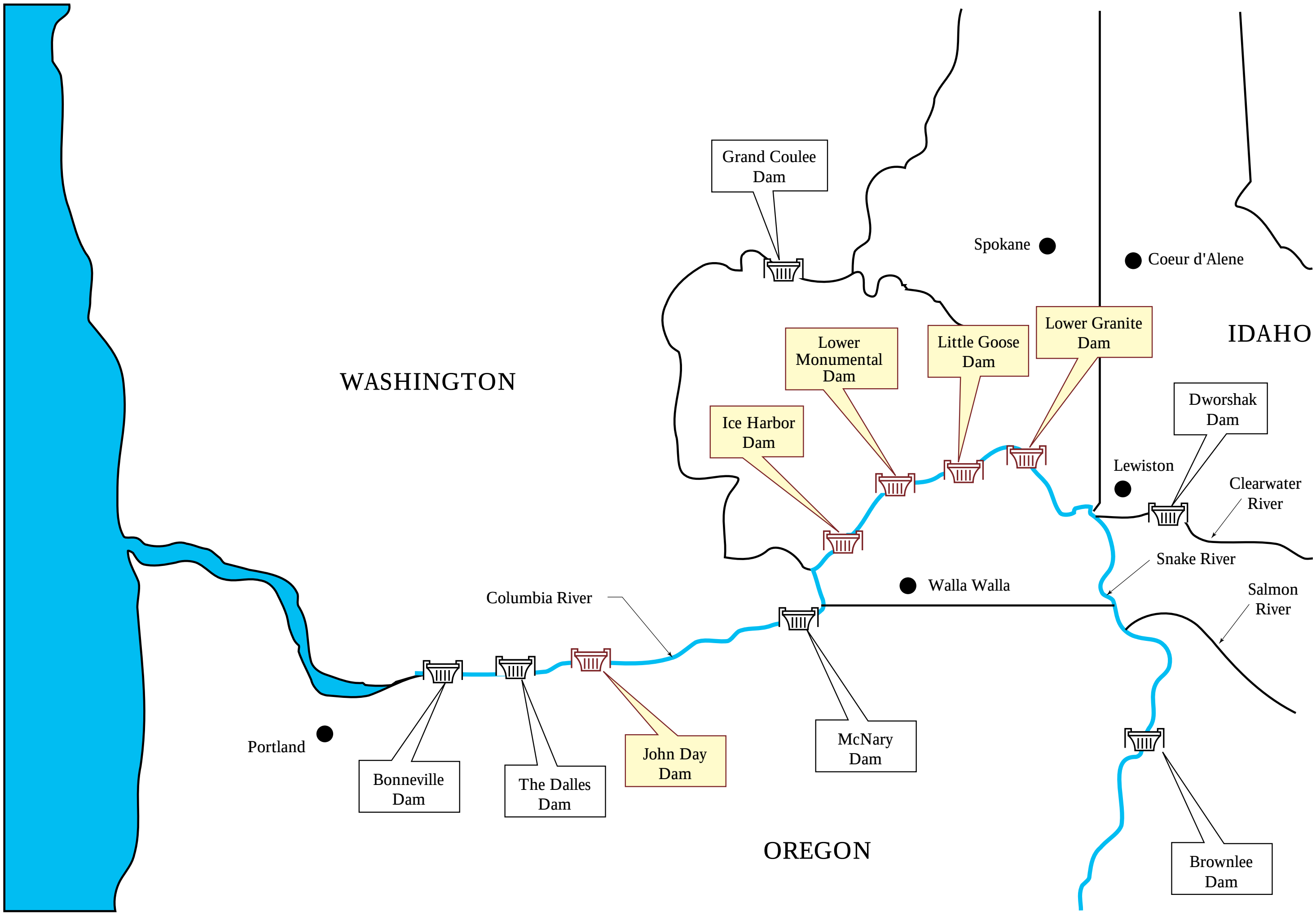
Dams

Hydropower projects block the fish's movement up and downstream. For fish trying to move upstream, a dam poses an impassable barrier unless fish ladders and mechanical lifts are provided. Fish moving downstream are often killed in the dam's turbines unless a spill flow or bypass is provided. Currently in the Columbia River Basin, 150 dams are in place.

Based on a study from the Natural Resources Conservation Service (NRCS), Sierra Club, and American Rivers, there are a number of alternatives that help the fish to make their journey up and down the rivers. In the past, fish would travel 2 to 3 weeks to reach the ocean; it now takes 2 months. Three cost-effective steps to aid the fish would be (a) spilling the fish past the dams, (b) drawdowns, and (c) adjusting flows. A combination of these steps will make our dams safe for the fish. By drawing down existing reservoirs, increasing river flows to a rate nearer the natural level, and allowing for spilling water, young fish will have a greater chance of survival.

Spilling water allows young fish to pass over a dam without going through the deadly turbine blades. Drawdowns release water from reservoirs allowing fish to be carried by the current instead of waiting in still pools, and flow increases the speed of the river making it easier for young fish to get to sea quickly.





Fish traveling to home streams in Idaho encounter a number of dams. The dams highlighted are under consideration for removal.

The 1997 spring runoff was projected to be near the largest on record for the Snake River and in the top 10 of historical record for the Columbia River. Spilling the water over the dam's spillway can help young fish get past the dams, but too much water spilling over the dams increases levels of dissolved gas in the water, which causes severe problems in the young fish. With 1997's high flows, controlling the excess water will be crucial to fish operations. It will be interesting to see the results.

Recently in Idaho, consideration is being given to eliminating four Snake River dams: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor. The John Day Dam in Oregon is also under consideration. A four-state council is weighing a proposal to remove the dams sometime early in the next century. The final decision is up to the National Marine Fisheries Service (NMFS), who is empowered to enforce the Endangered Species Act and is charged with developing a salmon recovery plan for the entire Northwest. This year the NMFS placed wild

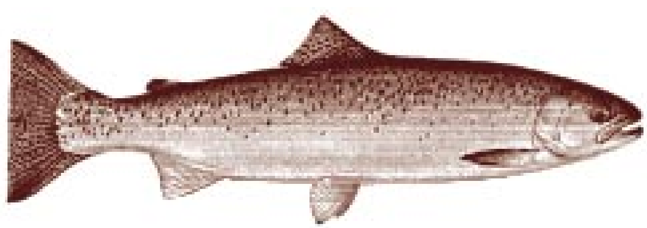
Idaho steelhead on the threatened list under the Endangered Species Act.

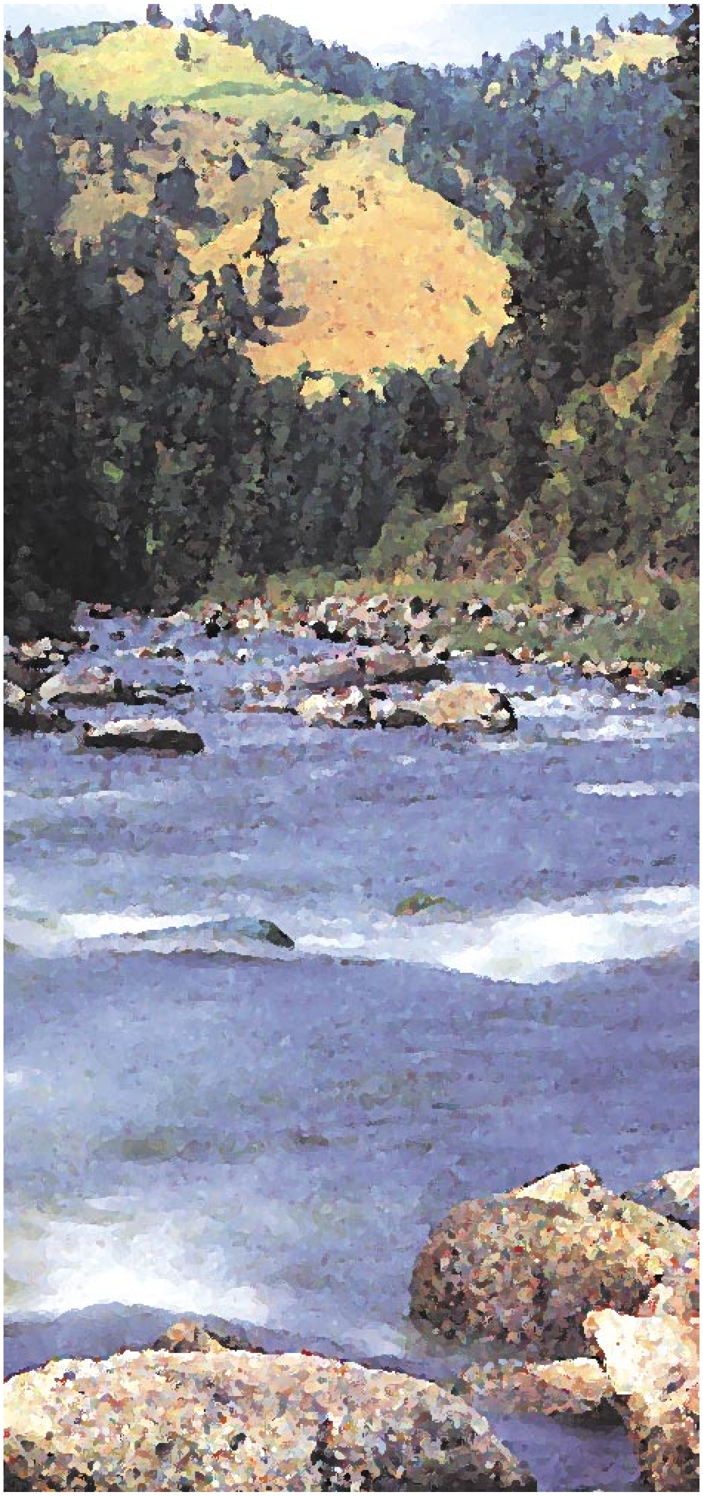
The Idaho Water Resource Board held three informational meetings in November to see if there was sufficient support to file for minimum stream flows on the lower Salmon and Jarbidge and Bruneau Rivers. Minimum flows help maintain flow instream for threatened and endangered salmon and steelhead during critical periods of their life cycle. It also prevents future excess diversion of water. The flow protects water quality and preserves the natural character of the river and riparian area. Three minimum streamflow water right applications were originally filed with the board by Idaho Rivers United in 1994.

Land Use

Land cultivation, roads, overgrazing, forest removal and fires, lumber and mining operations contribute to the lack of natural ground cover that provides slow drainage into streams, maintaining even flows and temperature. In semiarid climates such as Idaho's, more water is diverted in the summer for irrigation, resulting in lower, often inadequate flows for fish.

The 1996 Farm Bill included a provision to help landowners establish conservation buffers, which include riparian areas along rivers, streams, and wetlands. The U.S. Department of Agriculture (USDA) is committed to helping farmers and other landowners create 2 million miles of conservation buffers by the year 2002. The National Conservation Buffer Initiative was a multiyear effort led by the NRCS in cooperation with USDA agencies—Farm Service Agency, Cooperative Extension Service, and the U.S. Forest Service—state conservation agencies, conservation districts, agribusinesses, and agricultural and environmental organizations.





Pollution

Streams and lakes are often receptacles for domestic and industrial waste. Sewage, oil, mining, and pulp and paper mill byproducts are discharged into streams and lakes. The damage is smothered or destroyed bottom aquatic foods and reduced water oxygen supplies, increased acidity, and unhealthy fungal growth. Toxic wastes cause dangerous cumulative effects and radioactive wastes raise stream temperature above the aquatic organism tolerance.

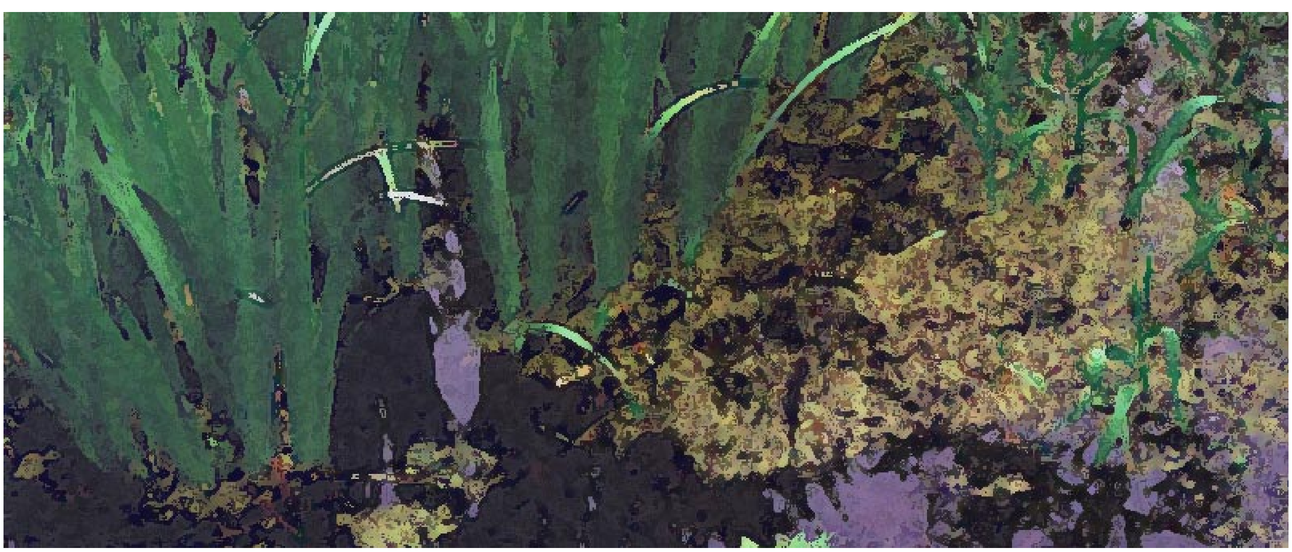
Can anything be done about this pollution? Yes, we can all work together to reduce and prevent this type of pollution, called nonpoint source pollution. This pollution results from a variety of human activities on the land, such farming, energy production, construction, and livestock operations. We all contribute to this pollution and may not even know it. Some of these activities are federal responsibilities, like ensuring federal lands are properly managed to reduce soil erosion. Some are state responsibilities, like developing legislation to govern mining and logging, and to protect groundwater. Some activities are handled locally by zoning or erosion control ordinances. Each individual can play a role by practicing conservation and by changing everyday habits, like practicing recycling.

The Environmental Protection Agency (EPA) is forming partnerships with stakeholder groups to encourage voluntary incentives on nonpoint source water pollution. The current partnerships include the National Association of Wheat Growers, National Pork Producers Council, National Cattlemen's Association, Southeastern Poultry & Egg Association, National Marine

Manufacturer's Association, International Marina Institute, National Association of Homebuilders, and the National Golf Foundation. The EPA works with these associations to adopt management practices that reduce nonpoint pollution by their memberships. In the 33/50 Program, the EPA asked industry to voluntarily refocus corporate policies and help meet program goals in reducing toxic chemical releases (in 1995, for example, total reductions reached 55%).

The environmental benefits of recycling are becoming well known. Many businesses, governments, and households are collecting discards for recycling, and recovering more materials than ever before. Over one-fifth of the municipal solid waste generated in our country is currently recycled or composted (EPA; www.epa.gov/docs/WhatsNew.html.).

All other problems aside, hatch success and natural production must be increased to allow enough of the smart, strong fish to survive the journey downstream to the ocean and later the return to their spawning beds. Our objective is to increase the percentage of fish hatched with a naturalized upbringing, understand natural fisheries production and mortality factors, and test different devices to enhance this environment.



Indian Summer III
Projects for 1997

Science as Group Problem Solving

A good way to show students the utility of science is to teach it as a problem-solving activity (Gilliland 1988). At the Shoshone-Bannock High School, we are using the environment as our classroom. Because Mother Earth is our home, what better place to teach the students! Starting with the environment, students can learn the scientific method of making a hypothesis and drawing conclusions from the evidence. This year we invited students from Shelley, Hillcrest, Idaho Falls, and Leadore High Schools to work with us on our group problem-solving experiments. As educators, we are building an environment that fosters learning and teaches respect curiosity, problem-solving skills, information gathering skills, and recording techniques. Students learn that the scientific method is a naturally occurring event; it happens every day in their lives.

There is much evidence that the educational experience needs to be improved for all students. Low levels of achievement, teenage suicide, and adult unemployment indicate the need for better education (Gilliland 1988). There are many causes for lack of achievement. Poor self-concept and lack of motivation on the part of the student may be largely responsible.

A publication (1996) by the Idaho Committee on Indian Education listed several goals and recommendations for improving Native American education. These goals include (a) preparing Indian children for future educational experiences by providing early childhood education programs that are culturally, linguistically, and developmentally appropriate; (b) establishing a school environment that respects, maintains, and promotes Native American values, languages, and traditions; (c) encouraging Native American parents, Tribal officials, and community leaders to participate in the education of children; and (d) raising the self-esteem and cultural pride of Native American students.

Project Goals and Scope

We believe that student projects, such as Indian Summer, is a step toward increasing student motivation, participation, and self-esteem. Projects like these encourage students to think independently and to interact confidently in group situations. Much like the struggling salmon and steelhead, Native American students have many hurtles to cross and need a healthy, safe environment in which to grow and thrive. We firmly believe that the Indian Summer projects are reaching these objectives, not for just Native Americans, but for all students.

The Indian Summer team developed three goals to help increase the hatch rate of salmon and steelhead in Idaho waters:

1. Examine current fish populations and habitat conditions
2. Determine what factors may be affecting fish populations
3. Address the factors limiting fish populations.

The following objectives were formulated to help students reach the goals of the project:

1. Test the technology for successful hatching
2. Increase egg to fry survival
3. Determine optimum incubator densities and configuration
4. Minimize cost
5. Minimize process

6. Minimize handling of fish
7. Test new equipment and designs
8. Increase community education and involvement.

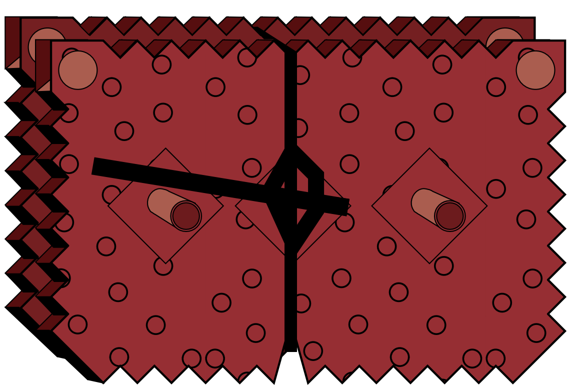
Since the streamside egg incubation project started in 1995, we have expanded from 4 to 20 sites. The 20 project sites are in the Salmon and Challis National Forests; Leadore, North Fork, Challis, Yankee Fork and Salmon/Cobalt districts; Sawtooth recreation area and extend over 200 miles within the Salmon River Drainage and on private lands. The project was divided into two areas: the north-end sites (downstream from Challis) and the south-end sites (upstream from Challis). The Shoshone-Bannock team coordinated efforts for the south-end sites, and the Idaho Model Watershed Project, Forest Service, and Idaho Fish and Game coordinated efforts for the north-end sites.

Equipment Designs and Methods

Based on the success of the 1995 and 1996 projects, the students decided to use the same methods in 1997 for the south-end sites. They used a modified incubator box and Whitlock Vibert (WV) boxes to hatch steelhead eggs obtained from the Pahsimeroi and Sawtooth hatcheries, and Slate Creek fish trap weir.

For the south-end sites, two new devices were added: the solar-powered fish data logging device and an upweller. The fish data logging device was powered by the sun during the day and by battery at night. Its purpose is to show when the fish moved. The young fry moved between 11:00 p.m. and 5:00 a.m. This was important because it showed us that the fish were beginning to act like wild fish, even at the fry stage.

Jordan/Scotty box



The upweller incubator is designed using a 5-gallon bucket, perforated plate, and irrigation diversion screen materials. The objective of the upweller was to see if its use would help solve the sediment problem. It was successful. The sediment settled on the bottom of the bucket, and the clear water remained on top.

For the north-end sites, different types of Washington State remote site incubators, Canadian Jordan/Scotty boxes, and the homemade Crystalex bucket upweller, in addition to the refrigerator incubator with WV boxes were tested.

Because of a variety of natural conditions and the new devices tested, the south-end live hatch rate was 80% as compared to the 90 to 95% rate we saw last year. The north-end live hatch rate dropped to 62% this year from 70% last year. The drop in the north-end sites' success resulted from not only new device tests, but also from water flow losses.

Whitlock Vibert Box and Hatch Box

The original Vibert box was developed in France in 1950 by Richard Vibert. The students' WV box is an improved version of the original WV box. It is larger in size than the original, uses more current materials and design, which improved its function. The box can be used for trout, salmon, and char eggs in any water that supports the species. The WV box is constructed of polypropylene and measures 145 × 90 × 60 mm. The sides, top, and bottom are various sized and shaped rectangular slots for water circulation, desilting, retaining and releasing the eggs and fry, and prohibiting predators from entering the hatch box. The incubator portion of the WV box protects the eggs until they are hatched. After they are hatched, the fry remain protected from predators in the nursery until the yolk sac is absorbed. Then, the fry escape through the slots and feed in pools and riffles of the stream.

The top lid of the WV box has sixty 3.5 × 13 mm slots for water circulation and swimup fry escape passage. It also restricts predators and works as a desilting mechanism. The flap of the top lid opens into the incubator and has sixty-nine 2 × 2-mm vents also for circulation, ventilation, predator protection, and silt retention. The incubator compartment can hold one or two layers of approximately 250 salmon eggs or 500 trout eggs. Typically, hatch success in the WV boxes averages from 75 to 95%. Fry that successfully leave the WV box and enter the stream average from 20 to 50% of the original number of eggs.

For the streamside incubator, the students modified the interior of an old refrigerator. Acrylic dividers and rocks were placed in the bottom of a refrigerator so water flowing through it created currents similar to a small nursery the stream. Water from the stream was supplied using 1-inch diameter polyvinyl chloride (PVC) piping. The students also built an oxygenator

Whitlock Vibert box

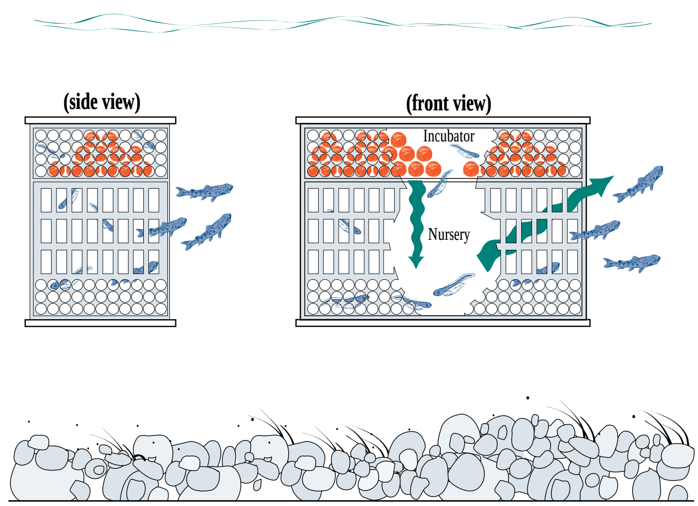
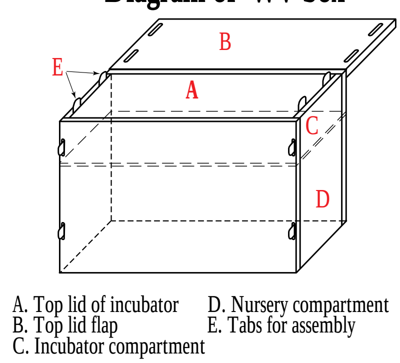


Diagram of WV box



(Whitlock Vibert box handbook)

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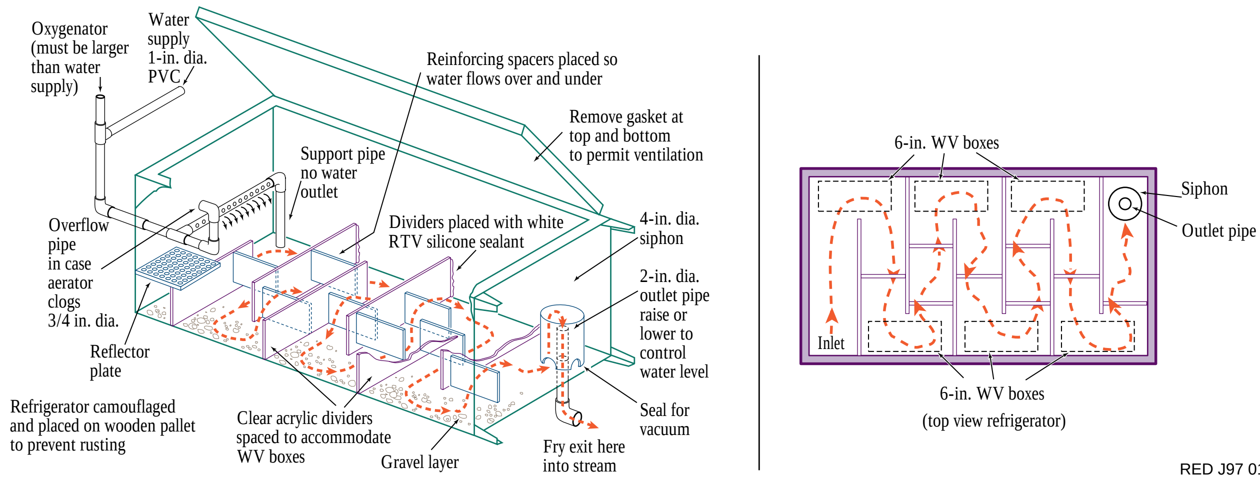
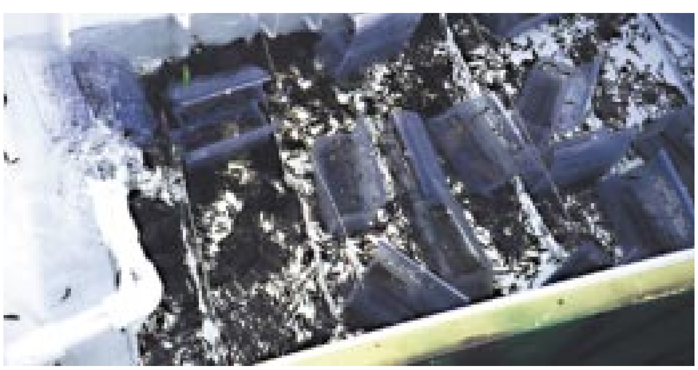
Trout Streamside Incubator



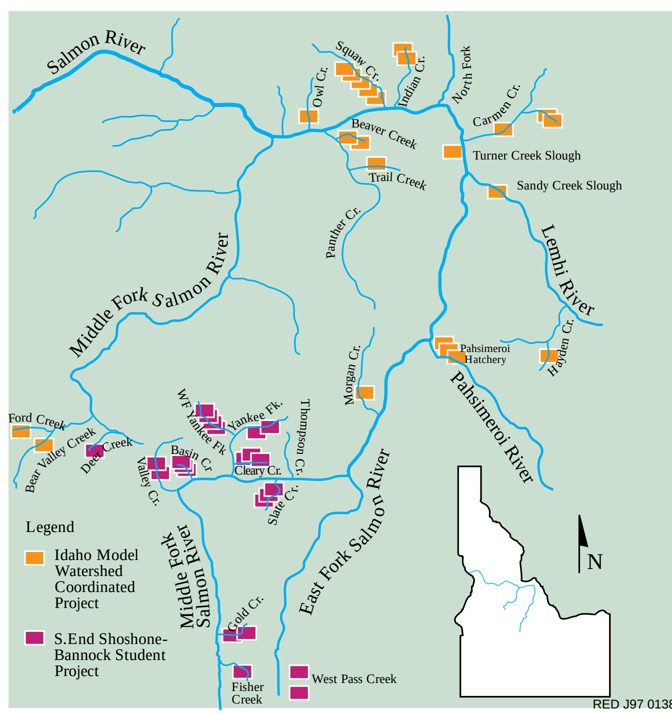
(Flaming Gorge/Lower Green River Chapter, Wyoming Trout Unlimited, Bone Draw Project)

and aerator with PVC pipe. A 2-inch diameter outlet pipe was used to control the water level and allow the fry to exit the incubator. The total cost of the converted incubator was $60.50. The incubator was camouflaged and placed at the side of the stream on a pallet to prevent it from rusting. The WV boxes fit along the sides within the incubator.

Unlike hatcheries, the incubator using the WV boxes allows the eggs to survive in an almost natural environment. Once the eggs are placed in the box, they are not handled again by humans. Much like natural spawning, eggs in the WV boxes are subject to random mortality, which allows the stronger, 'smart' fish to develop greater survival skills. The new fry protected in the incubator develop a more advanced yolk sac, producing stronger, mature fry, that after leaving the box, have a better chance of survival from natural losses.



Eggs at the fry stage.



Locations and numbers of incubator devices for the 1997 project.

Fish Data Logging Device

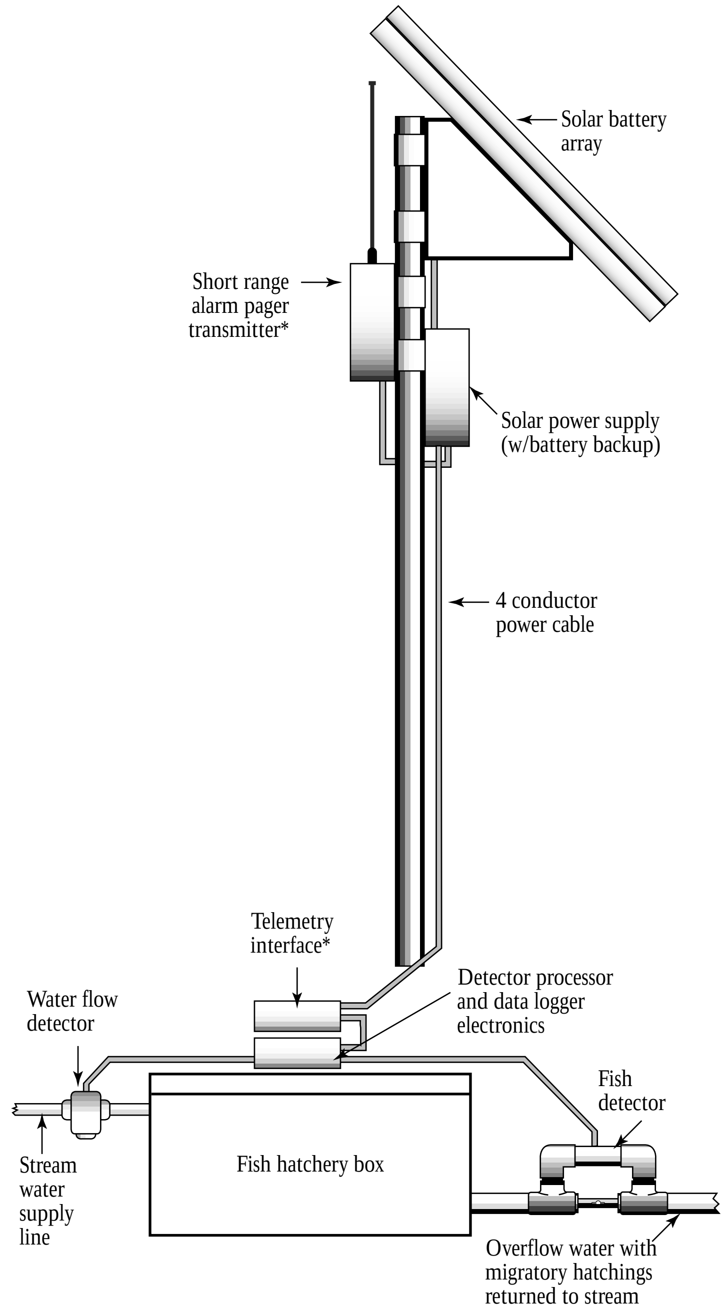
The fish detector device shown is a working model of a fish detector built and field tested by the Shoshone-Bannock Indian Summer III project team. This detector monitors the outflow from the streamside incubators. Any fish leaving the hatchery are detected and logged, allowing data to be collected on the migration habits of newly hatched fish.

A narrow channel houses an infrared emitter and detector to detect passing fish, and a bypass channel carries any hatchery outflow not able to pass through the detector channel. Fish are prevented from traveling through the bypass channel by a screen placed in the inlet and outlet of the device.

The detector is assembled with standard irrigation-type PVC fittings and pipe. The box mounted at the top right is the junction box in which wires from the emitter and detector are spliced to single shielded cable that runs to the logger apparatus. This particular unit is fitted with a calibration pot and jack to make setting up the monitor in differing light easier.

The fish screen, used to make fish exit via the detector channel, is made from a piece of nylon mesh. The material is cut to just the size needed to fully fit the inside circumference of the 'T' fitting. The seam where the two ends of the plastic meet are positioned at the bottom of the fitting, 180 degrees away from the bypass outlet. The largest feeder pipe going into the hatch box is 1 inch, so a 1.5-inch pipe is used for the T fittings and bypass section. Two-inch assemblies are also used because many of the discharge pipes in the newer hatch boxes are constructed of 2-inch PVC.

Fish data logging device



** Items marked are optional system elements*

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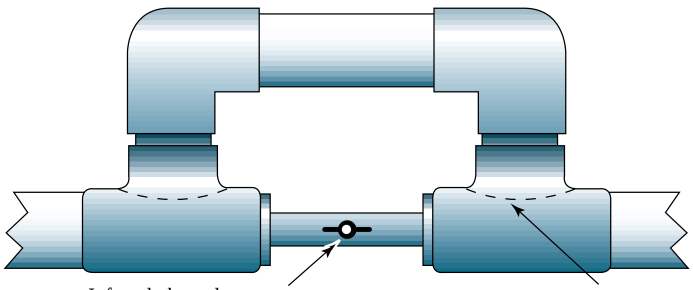
(http://pw1.netcom/~t-rex/fishdata.html)

Fish detector



(http://pw1.netcom/~t-rex/fishdata.html)

RED J97 0134

The detector channel is constructed from 0.75-inch PVC pipe, fitted to the rest of the detector assembly with two PVC reduction fittings. The channel is painted black on the outside so no light will enter the channel around the sensors. An infrared emitter and detector are inserted into the channel through two small holes drilled exactly opposite of each other in the PVC pipe. Tightly twisted lead wires run to the junction box at the top of the assembly. When operating, the infrared detector is illuminated by the emitter and biased just beyond the switch-on point.

Anything interposing itself between the emitter and detector will cause the detector to switch off, signaling the presence of something in the fish gate. The majority of the fish traveling the detector channel will do so in the middle, because the velocity of the water is quickest there, as opposed to the area nearest the inside wall of the pipe. A single infrared detector pair covering the middle of the channel seems to detect the migration of fish satisfactorily. The unit is used to detect and measure migration patterns, not count fish, and the detector seems well suited to this use.

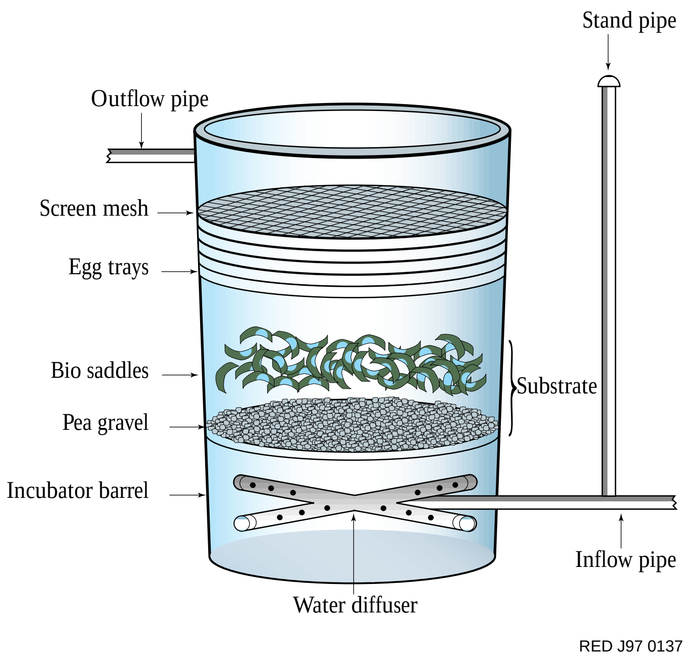
Using this fish data logging device, we found that the fish departed at about the same time of day (11:00 p.m. through 5:00 a.m.) at the first of the month (8/2/97 through 8/9/97). With the aid of the logging device, we saw that the fry left the hatch box at night, when it was cool. This was the best time for them to survive on their own.

Upweller Design

Upweller incubator devices were evaluated at the north and south-end sites. The upweller was designed using 5 to 10-gallon plastic buckets or 50-gallon barrels with lids. The buckets have inlet and outlet pipes to allow the water to run through. Inside the bucket, there is water diffuser, filter screens, substrate, and up to 5 egg trays. As the water flows through the bucket, the bottom filter screen keeps sediment and leaves from settling in the egg trays. The plastic egg trays hold the eggs until they hatch. Once the eggs hatch into fry, they drop through 1/4 × 1/2-inch slots in the trays to the artificial substrate layer, which are plastic fortune cookie-shaped

Students at Fisher Creek hatch box.

Upweller device



(Washington State Remote Site Incubator)

pieces, in the middle of the bucket. The substrate keeps the fry above the sediment that has settled in the bottom of the bucket. At the bottom of the bucket, there is another filter screen with a 1/4-inch layer of pea gravel that keeps the bottom layer of sediment from the fry. The fry exit the bucket through the outlet pipe to enter the stream. Homemade versions of the concept were made using Crystalex buckets.

Assessing Fish Habitat and Stream Conditions

In accessible waters today, fish populations should be maintained by natural production alone. Everything possible should be done to enhance breeding, such as adequate protection during spawning, making spawning beds easy to reach, and ensuring healthy stream conditions. Following their natural instincts, salmon and trout inhabit streams and lakes because the food and water conditions are favorable. For this reason alone, every effort should be made to protect and maintain the balance of fish in Idaho waters.

Physical and chemical stream conditions are important in producing and distributing salmon and trout. Temperature, water clarity, flow, and oxygen contribute to healthy streams.

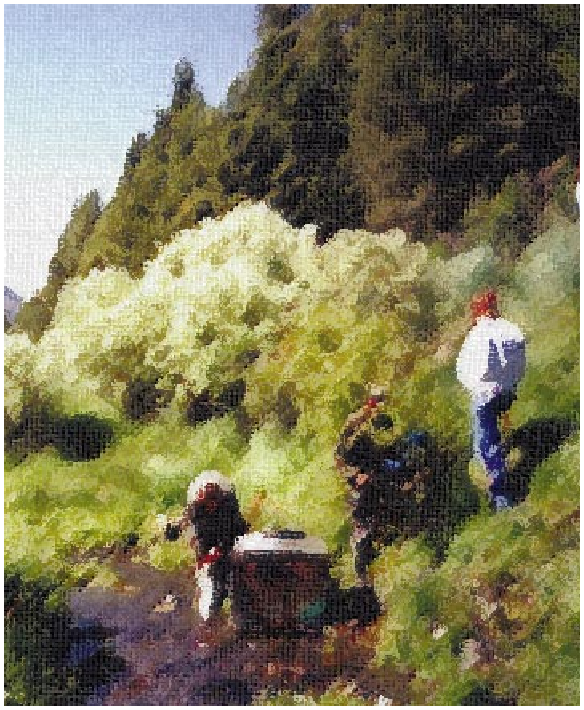
To learn to effectively manage and enhance fish populations, the students gathered basic physical and biological data. With the help of community mentors, they analyzed the data to determine population status and factors limiting fish production.

Table 1 shows the life history survival rate for three steelhead production strategies: hatchery, wild, and incubator. The difference between the hatchery and incubator in the number of adults produced is minimal; however, the difference in production cost is large—the hatchery is more expensive than the incubator.

Table 1. Expected life history survival for three production strategies. Starts with 40 steelhead (20 males, 20 females); progression from left to right.

Strategy	*Eggs*	*Survival rate (%)*	*Eyed eggs*	*Survival rate (%)*	*Fry*	*Survival rate (%)*	*Smolt*	*Survival rate (%)*	*Adults*
Hatchery	100,000	95	95,000	95	90,250	95	85,750	3/10	258
Wild	100,000	--	--	10	10,000	38	3,800	6/10	23
Incubator	100,000	95	95,000	95	90,250	38	34,300	6/10	206

Streamside Data Collected by Students



The students conducted five streamside tests: (1) temperature, (2) nitrate (NO_3), (3) dissolved oxygen (DO), (4) millimeter (mm) size of the eggs and fry, and (5) pH acid or base readings in the boxes and stream. The boxes were monitored daily for 10 days and then weekly for 60 days. A summary of the results follows.

Temperature

Temperature was measured to see if the hatch boxes would hold temperature consistently. We found that they did, with temperatures ranging from 3°C (Basin Creek) to 10°C (Fisher Creek). The temperatures remained consistent every day during the project time (62 days). We had extremes in outside temperatures from -2°C (upper West Fork) to 23.3°C (lower West Pass).

Spring temperatures remained the same. However, we had a wet summer, which resulted in high amounts of sediment and fast moving, muddy river water. Although some of the streams were high in sediment, all the fry had exited the hatch boxes before that time.

Nitrate

(NO_3) was measured to indicate (1) possible pollution in the streams and (2) pollution of fry in the hatch boxes. We wanted to know if the longer the fry spent in the boxes, would they make a greater concentration of their own pollution, and if those concentrations were toxic to the fry. We found that the majority of the boxes were at 0 mg/liter. A few of the boxes reached 1 mg/liter, but this was at the end of the study time.

Dissolved Oxygen

DO was monitored to make sure the eggs had enough oxygen to sustain life. The range was high as one would expect in a mountain stream. We were interested in knowing if levels of DO would drop in our incubators as time went on. They stayed the same. Ranges were from 8 mg/liter to 12 mg/liter (upper Cleary Creek to upper West Fork).

Millimeter Size

The size in mm was used to monitor growth of the fry. We were interested in knowing if their size continued to increase once the eggs were in the hatch boxes. Remember, we do not feed the fry once they are in the boxes. Ranges were from 0 mm (6/10/97) to 20–30 mm (8/10/97). We noted good growth during the project time (62 days).

Acid or Base of the Stream

The pH of the stream is important to the well being of fry. We were interested in knowing if the pH of the fry in the boxes would change as a result of their environment. We saw no change in stream versus the boxes. The range was 7.0 to 8.0 in all boxes.

Summary of Data

Table 2 summarizes the results of the streamside incubator project. The high school students gathered the data for the south-end sites. This area is located below the Galena Summit to the White Clouds area (East Fork of the Salmon River). The students had 560,435 eggs and the hatch rate was 89.37%. The north end consisted of the lower Salmon River country, mainly from the Middle Fork to Challis and was jointly carried out by private landowners, Idaho Model Watershed Project, Idaho Fish and Game, and the Salmon and Challis National Forest staff. The north-end sites had a 62% live hatch rate and the south-end sites had an 89.37% live hatch rate. The hatch rates for all areas in the study are shown in Table 2. The map on page 14 shows the hatch box locations.

1997 Indian Summer III Science Action Team.

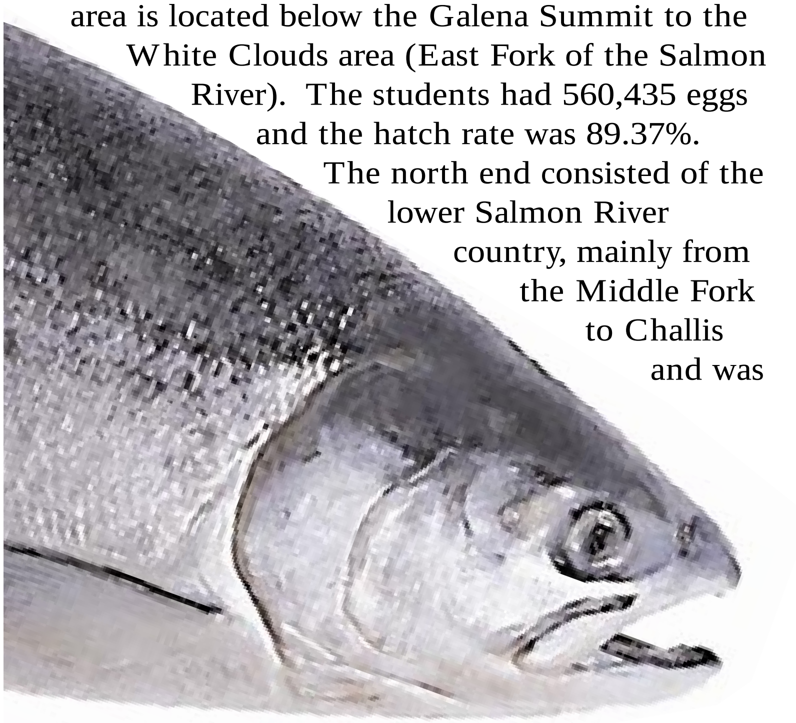


Table 2. Summary of results of the Salmon River streamside incubation project. (WV boxes and refrigerator incubators used except where noted).

Area	*Box No.*	*No. eggs*	*No. live fry*	*Hatch rate (%)*	*Comments*
North-end Sites					
Morgan Creek	1	50,000	49,000	98	Optimum conditions
Hayden Creek Drainage					
Ford Creek	1	25,000	23,750	95	Optimum conditions
Deer Creek	1	25,000	3,750	15	Loss of flow
Bear Valley Creek	1 JSB	8,000	7,760	97	Optimum conditions
Bear Valley Creek Spring	1 RSI	77,700	7,500	10	Loss of flow
Indian Creek					
Ranch	1	25,000	2,500	10	Loss of flow
Spring	1 box/1CBU	25,000	22,500	90	1 optimum conditions/1 loss of flow
Beaver Creek/Trail Creek	2	50,000 eggs planned		0	Not operated in 1997
Live hatch rate for north-end sites		440,000	254,000	62	
South-end Sites					
Sandy Creek Slough	1	23,000	20,700	90	Optimum conditions
Turner Slough	1 JSB	5,000	4,800	96	Optimum conditions
Carmen Creek	1	25,000	5,000	20	Sediment problem
after runoff		12,400	11,500	90	
Freeman Creek	1 and 2	25,000	24,250	97	Optimum conditions
Squaw Creek	1 and 2 CBUs 1, 5-gal RSI	56,000	53,200	95	Optimum conditions
Owl Creek	1 1, 5-gal RSI	50,000	30,000	60	Optimum conditions
Pahsimeroi Hatchery	1 box 1 CBU 1, 5-gal RSI	8,000	7,520	94	Optimum conditions
Gold Creek	1	20,300	19,869	97.8	
Gold Creek	2	20,200	19,824	98.13	
Valley Creek	1	25,000	24,648	98.59	
Valley Creek	2	25,000	24,583	98.3	
Basin Creek	1	34,000	26,269	77.26	
Basin Creek	2	36,400	34,364	94.4	
Basin Creek	3	30,000	24,041	80.1	
Cleary Creek	1	37,400	34,547	92.3	
Cleary Creek	2	30,000	28,409	94.6	
Cleary Creek	3	2,400	2,304	96	
Upweller		800	647	80.8	
Slate Creek	1	34,915	33,866	96.9	
Slate Creek	2 and 3	67,320	65,180	96.82	
Fisher Creek	1	35,000	17,406	49.73	
Lower West Pass Creek	1	25,000	24,153	96.6	
Upper West Pass Creek	2	25,000	23,809	95.2	
West Fork Yankee Fork	1	27,500	26,704	97.1	
West Fork Yankee Fork	2	30,000	21,300	71	
West Fork Yankee Fork	3	29,200	28,750	98.4	
West Fork Yankee Fork	4	25,000	20,200	80.8	
Live hatch rate for south-end sites		560,000	501,000	89.37	
Total		1,000,000	755,000	76	

Notes:

JSB= Canadian Jordan/Scotty Boxes

RSI= Washington State Remote Site Incubator

CBU=Crystalex Bucket Upweller

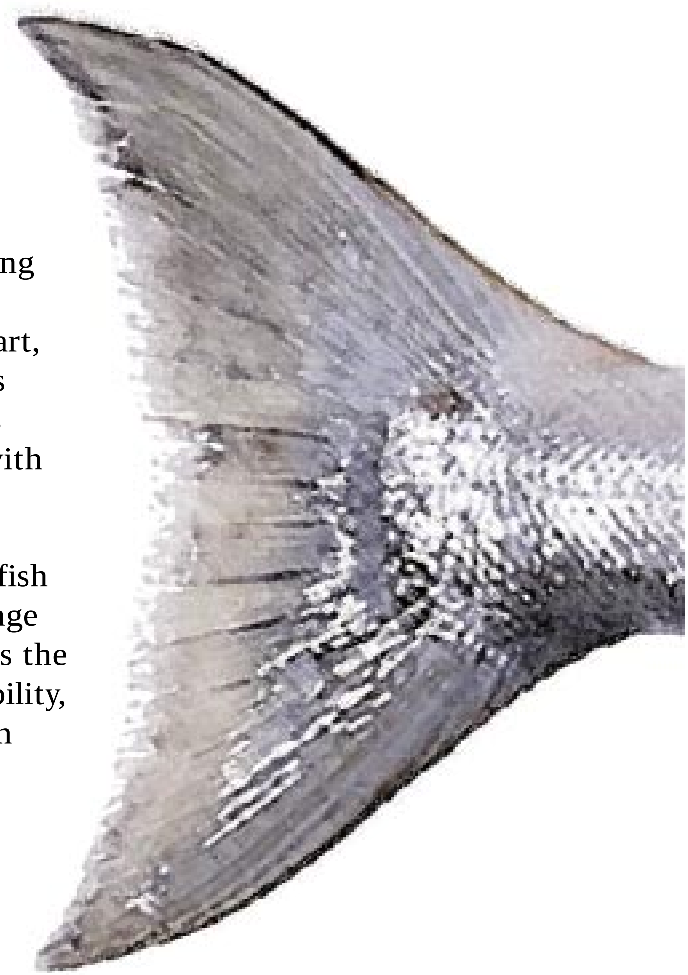
Salmon Egg Placement Project

In the fall, we will be placing Chinook salmon eggs in Warm Lake, the headwaters of the South Fork of the Salmon River and its tributaries. The salmon fry will leave the hatch box in February 1998. We will then have data to compare the salmon and steelhead hatch rates. This is our first attempt at placing salmon eggs, and we hope that it is as fruitful as the steelhead project. This will also be the first time we have used the streamside incubators and WV boxes in the winter. The salmon placement project is managed completely by the Tribe. We will maintain and care for all these salmon eggs.

Evaluating the Indian Summer III Project

'As you can see, the traditional thinking of the American Indians is a major factor in the way they think about saving the salmon. Their desire to maintain a salmon population that is viable protects their immediate needs, and also the needs of the future, American Indian or not.'—Ted Strong, Columbia River Intertribal Fish Commission

At no other time in the century, have Native Americans been in a position to influence changes in education and fish recovery programs. Native American communities are bringing forward traditional natural law systems for the sake of future generations and all living things. By helping students to learn ecological wisdom through seeing and listening, we can pass down information through ritual, art, and practical example. Hands-on learning, seeing results from their efforts through experiential learning enhances their science and math skills and provides our children with valuable tools to meet the future.

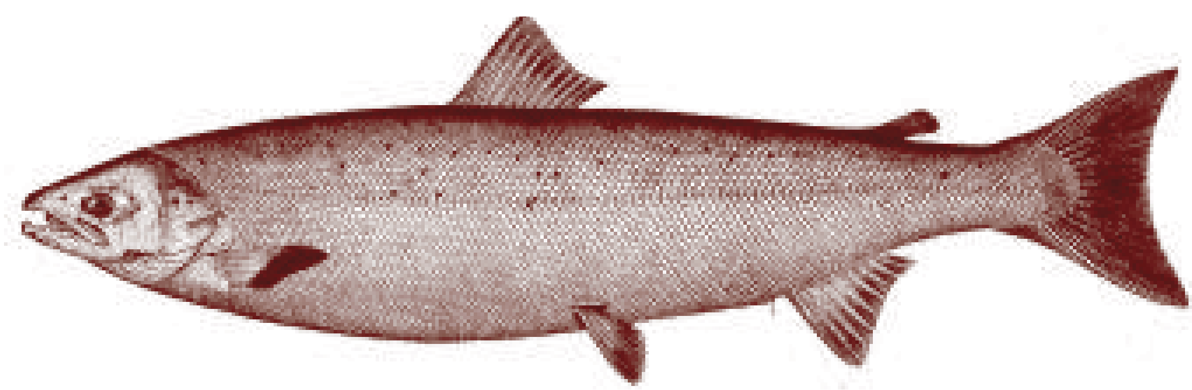


It is a great honor to work with the youth of two tribes: fish and students. Change must come from within, and change takes time. Achievement for the fish and students means the same thing. Achievement is accomplishment through ability, effort, and courage. Achievement is creative contribution and giving. The Indian Summer students are achievers. They are working for the good of the fry and to help themselves. In return, they are giving back to society by surviving, making a good life, taking care of family, and being life-long learners. They are learning to give, and this is what is important.

Summer of '97

To this day I can recall,
The best summer I've had of all,
The winding rugged roads,
And all the memories that it holds,
Is up to me to be told,
Blue mountains and green trees,
All around as far as the eye can see,
And then the hidden dusk comes crawling in,
The day is almost at the day's end,
Hamburgers and hotdogs on an open grill,
Soon our hunger is fulfilled,
Around the fire everyone gathers,
Laughing and talking seems like for hours,
Rain, lightning and thunder says it's time to rest,
Away in our tents we are nodding off,
The rain and the thunder's story is the last we hear,
We fall asleep but not for long,
Soon the birds awake and sing their morning song,
Then off in the distance I hear "First wake up call,"
And just then a new day filled with freedom starts for all.

—Autumn Pratt



The Indian Summer project is part of the Shoshone-Bannock Tribe program called *Dance of the Salmon*, which undertakes environmental studies and encourages tribal students to use their skills to build a better future.

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Ben Rinehart, Lockheed Martin Idaho Technologies Company, P.O. Box 1625, Idaho Falls, Idaho 83415-3830, (208) 526-1002.

Streamside Incubator Designs

Refrigerator Incubator Design, Flaming Gorge/Lower Green River Chapter, Wyoming Trout Unlimited, Bone Draw Project. Contact Dr. Fred Eales (307) 382-4857.

Washington State Remote Site Incubators (Upweller Design). Contact Jerry Manuel (360) 427-2161.

Jordan/Scotty Boxes, B.C. Canada. Contact Blaney Scott (250) 382-0141.

Whitlock Vibert Boxes, Federation of Fly Fishers. Contact Evelyn Taylor (406) 585-7592.